

Claims

What is claimed is:

- 5 1. A method for analyzing warranty data comprising the steps of:
 receiving first warranty claim data for a first item over a first time interval;
 receiving first warranty claim data for at least one second item over the first
time interval;
 generating a statistical control chart for the first item, including at center line
10 and an upper control limit, by employing a statistical process control methodology;
 receiving second warranty claim data for the first item over a second time
interval that is subsequent to the first time interval;
 receiving second warranty claim data for the at least one second item over the
second time interval;
15 creating a proportionality metric for the first item relative to the second time
interval;
 comparing the proportionality metric to the upper control limit; and
 generating a report when the proportionality metric exceeds the upper control
limit.
20 2. The method of claim 1 wherein said second warranty claim data for the
first item includes a certain number of claims, the second warranty claim data for the
at least one second item includes a certain number of claims; and wherein said
proportionality metric is created by adding the certain number of claims for the first
25 item to the certain number of claims for the at least one second item to create a sum,
and dividing the certain number of claims for the first item by the sum.
 3. The method of claim 1 wherein the step of generating a statistical control
chart includes:
30 determining a plurality of proportionality metrics over consecutive
subintervals within the first time interval;
 calculating an initial centerline and initial upper and lower control limits;
 replacing each proportionality metric, within the plurality of proportionality

metrics, that exceeds the initial upper control limits with the upper control limit, and replacing each proportionality metric, within the plurality of proportionality metrics, that is less than the initial lower control limit with the lower control limit to create a modified plurality of proportionality metrics; and

5 recalculating the centerline based on the modified plurality of proportionality metrics.

4. The method of claim 1 further including the steps of:

 receiving third warranty claim data for the first item and for the at least one
10 second item over a third time interval that is consecutive to the second time interval;
 creating a second proportionality metric for the first item relative to the third time interval;

 receiving fourth warranty claim data for the first item and for the at least one second item over a fourth time interval that is consecutive to the third time interval;
15 creating a third proportionality metric for the first item relative to the fourth time interval;

 receiving fifth warranty claim data for the first item and for the at least one second item over a fifth time interval that is consecutive to the fourth time interval;
 creating a fourth proportionality metric for the first item relative to the fifth
20 time interval;

 receiving sixth warranty claim data for the first item and for the at least one second item over a sixth time interval that is consecutive to the fifth time interval;
 creating a fifth proportionality metric for the first item relative to the sixth
25 time interval;

 receiving seventh warranty claim data for the first item and for the at least one second item over a seventh time interval that is consecutive to the sixth time interval;
 creating a sixth proportionality metric for the first item relative to the seventh time interval;

 receiving eighth warranty claim data for the first item and for the at least one
30 second item over a eighth time interval that is consecutive to the seventh time interval;

 creating a seventh proportionality metric for the first item relative to the eighth time interval;

receiving ninth warranty claim data for the first item and for the at least one second item over a ninth time interval that is consecutive to the eighth time interval;
creating a eighth proportionality metric for the first item relative to the ninth time interval;

5 receiving tenth warranty claim data for the first item and for the at least one second item over a tenth time interval that is consecutive to the ninth time interval;
creating a ninth proportionality metric for the first item relative to the tenth time interval; and

generating a report it the proportionality metric, the second proportionality
10 metric, the third proportionality metric, the fourth proportionality metric, the fifth proportionality metric, the sixth proportionality metric, the seventh proportionality metric, the eighth proportionality metric, and the ninth proportionality metric are all above the centerline.

15 5. The method of claim 1 further including the steps of:

receiving third warranty claim data for the first item and for the at least one second item over a third time interval that is consecutive to the second time interval;
creating a second proportionality metric for the first item relative to the third time interval;

20 receiving fourth warranty claim data for the first item and for the at least one second item over a fourth time interval that is consecutive to the third time interval;
creating a third proportionality metric for the first item relative to the fourth time interval;

receiving fifth warranty claim data for the first item and for the at least one
25 second item over a fifth time interval that is consecutive to the fourth time interval;
creating a fourth proportionality metric for the first item relative to the fifth time interval;

receiving sixth warranty claim data for the first item and for the at least one second item over a sixth time interval that is consecutive to the fifth time interval;
30 creating a fifth proportionality metric for the first item relative to the sixth time interval;

receiving seventh warranty claim data for the first item and for the at least one second item over a seventh time interval that is consecutive to the sixth time interval;

creating a sixth proportionality metric for the first item relative to the seventh time interval; and

generating a report if the proportionality metric, the second proportionality metric, the third proportionality metric, the fourth proportionality metric, the fifth
5 proportionality metric, and the sixth proportionality metric are increasing in value from the proportionality metric through the sixth proportionality metric.

6. The method of claim 1 further including the steps of
calculating a 2-sigma limit above the centerline for the statistical control
10 chart;

receiving third warranty claim data for the first item and for the at least one second item over a third time interval that is consecutive to the second time interval;

creating a second proportionality metric for the first item relative to the third time interval;

15 receiving fourth warranty claim data for the first item and for the at least one second item over a fourth time interval that is consecutive to the third time interval;

creating a third proportionality metric for the first item relative to the fourth time interval; and

generating a report if at least two of the proportionality metric, the second
20 proportionality metric and the third proportionality metric are greater than the 2-sigma limit.

7. The method of claim 1 further including the steps of:
calculating a 1-sigma limit above the centerline for the statistical control
25 chart;

receiving third warranty claim data for the first item and for the at least one second item over a third time interval that is consecutive to the second time interval;

creating a second proportionality metric for the first item relative to the third time interval;

30 receiving fourth warranty claim data for the first item and for the at least one second item over a fourth time interval that is consecutive to the third time interval;

creating a third proportionality metric for the first item relative to the fourth time interval;

receiving fifth warranty claim data for the first item and for the at least one second item over a fifth time interval that is consecutive to the fourth time interval; creating a fourth proportionality metric for the first item relative to the fifth time interval;

5 receiving sixth warranty claim data for the first item and for the at least one second item over a sixth time interval that is consecutive to the fifth time interval; creating a fifth proportionality metric for the first item relative to the sixth time interval; and

generating a report if at least four of the proportionality metric, the second
10 proportionality metric, the third proportionality metric, the fourth proportionality metric, and the fifth proportionality metric are greater than the 1-sigma limit.

8. The method of claim 1 wherein the first item and the at least one second item each comprise one of a part, subassembly or an attribute of a vehicle.

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9. The method of claim 1 wherein the step of receiving first warranty claim data for a first item over a first time interval includes receiving the number of first items that are in service for a plurality of subintervals within the first time interval, and receiving the number of warranty claims for the first item within each subinterval
20 of the plurality of subintervals; and the step of generating a statistical control chart includes, for each subinterval in the plurality of subintervals, dividing the number of warranty claims for the subinterval by the number of first items in service for the corresponding subinterval to create a plurality of P-values, and determining the centerline and the upper control limit from the plurality of P-values.

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10. The method of claim 9 wherein the step of generating a statistical control chart includes standardizing the control chart in units of standard deviation.

11. The method of claim 10 wherein standardizing the control chart includes
30 standardizing each of the P-values in the plurality of P-values by calculating a mean P-value from the plurality of P-values, calculating a standard deviation for each of the P-values in the plurality of P-values, and determining a standardized P-value for each of the P-values in the plurality of P-values by subtracting the mean P-value from

each of the P-values in the plurality of P-values to create a plurality of difference P-values, and then dividing each P-value in the plurality of difference P-values by the corresponding standard deviation for each of the P-values in the plurality of P-values.

- 5 12. A method for analyzing warranty data comprising the steps of:
- receiving first warranty claim data for a first item over a first time interval,
with the first time interval including a plurality of subintervals and the number of
warranty claims for the first item in each subinterval within the plurality of
subintervals;
- 10 receiving the number of the first item covered under warranty for each
subinterval in the plurality of subintervals;
- creating a P-value for each subinterval in the plurality of subintervals by
dividing the number of warranty claims for the first item in each of the subintervals
by the number of first items in service for the corresponding subinterval;
- 15 generating a statistical control chart for the first item, including at center line
and an upper control limit, by employing a statistical process control methodology to
the P-values created for each of the subintervals;
- receiving second warranty claim data for the first item over a second time
interval that is subsequent to the first time interval, including the number of warranty
20 claims and the number of first items in service in the second time interval;
- creating a proportionality metric for the first item relative to the second time
interval by dividing the number of warranty claims in the second time interval by the
number of the first item in service in the second time interval;
- comparing the proportionality metric to the upper control limit; and
- 25 generating a report when the proportionality metric exceeds the upper control
limit.

- 30 13. The method of claim 9 wherein the step of generating a statistical control
chart includes standardizing the control chart in units of standard deviation.

 14. The method of claim 10 wherein standardizing the control chart includes
standardizing the P-value for each subinterval by calculating a mean P-value from the
P-value in each subinterval, calculating a standard deviation for each of the P-values

in each of the subintervals, and determining a standardized P-value for each subinterval by subtracting the mean P-value from the P-value in each subinterval to create a difference P-value in each interval, and then dividing each of the difference P-values by the corresponding standard deviation.

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15. The method of claim 12 further including:

receiving a plurality of warranty claim data for a corresponding plurality of time intervals equal in length and subsequent to the second time interval;

10 creating a plurality of proportionality metrics, with each of the proportionality metrics in the plurality of proportionality metrics corresponding to one of the time intervals in the plurality of time intervals;

comparing the plurality of proportionality metrics to a pattern rule; and

generating a report if any of the proportionality metrics match the pattern rule.

15 16. In an information processing and storing apparatus, a method for analyzing warranty data comprising the steps of:

20 receiving first warranty claim data for a first item over a first time interval, with the first time interval including a first plurality of subintervals and the number of warranty claims for the first item in each subinterval within the first plurality of subintervals;

receiving the number of the first item covered under warranty for each subinterval in the first plurality of subintervals;

25 creating a P-value for each subinterval in the first plurality of subintervals by dividing the number of warranty claims for the first item in each of the subintervals by the number of first items in service for the corresponding subinterval;

receiving second warranty claim data for the first item over a second time interval that is subsequent to the first time interval, with the second time interval including a second plurality of subintervals, each equal in length to corresponding subintervals of the first time interval, including the number of warranty claims and
30 the number of first items in service in each subinterval within the second plurality of subintervals;

creating a P-value for each subinterval in the second plurality of subintervals by dividing the number of warranty claims for the first item in each of the

subintervals by the number of first items in service for the corresponding subinterval;
subtracting the P-values in each interval in the second plurality of
subintervals from the P-values in each corresponding subinterval in the first plurality
of subintervals to create a plurality of difference P-values;

5 generating a statistical control chart for the first item, including at center line
and an upper control limit, by employing a statistical process control methodology to
the plurality of difference P-values;

 comparing the difference P-value for at least one subinterval of the second
plurality of subintervals to the upper control limit; and

10 generating a report when the difference P-value for the at least one
subinterval of the second plurality of subintervals exceeds the upper control limit.

17. The method of claim 16 further including the steps of calculating a
plurality of standard error difference in proportion for each subinterval of the second
15 plurality of subintervals; and normalizing the plurality of P-values relative to the
corresponding standard error difference from the plurality of standard error difference
in proportion.

18. The method of claim 17 further including:
20 comparing the plurality of difference P-values to a pattern rule; and
 generating a report if at least some of the difference P-values in the plurality
of difference P-values match the pattern rule.